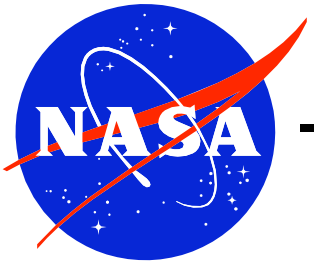
GAMMA-RAY LARGE AREA SPACE TELESCOPE (GLAST) PROJECT

STATEMENT OF WORK (SOW) FOR CONTRACT NAS5-00147

LARGE AREA TELESCOPE (LAT) INSTRUMENT

March 27, 2002



GODDARD SPACE FLIGHT CENTER
GREENBELT, MARYLAND

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GAMMA-RAY LARGE AREA SPACE TELESCOPE (GLAST)

PROJECT

STATEMENT OF WORK (SOW)
FOR
CONTRACT NAS5-00147

LARGE AREA TELESCOPE (LAT) INSTRUMENT

March 27, 2002

NASA Goddard Space Flight Center

Greenbelt, Maryland

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Statement of Work (SOW) for Contract NAS5-00147 for the Gamma Ray Large Area Telescope (GLAST)

1.0 Introduction

The contractor shall develop and provide the GLAST Large Area Telescope in accordance with this Statement of Work.

2.0 Scope

The contractor shall have responsibility for the instrument design and development and shall provide all necessary personnel, services, materials, equipment, and facilities necessary for the instrument management, design, analysis, development, fabrication, calibration, integration and test, and delivery of the flight instrument to NASA; support integration of the instrument to the spacecraft; design and fabricate an Instrument Operations Center (IOC), and support instrument operations.

The effort includes delivery of a flight model instrument, an engineering model and calibration model of one instrument tower, all GSE necessary to fabricate and test, and support spacecraft integration, an engineering model to fly on a suborbital balloon flight, and the effort required to accomplish the balloon flight. It also includes all flight and ground software, and software and science support to accomplish the science investigations. The effort includes monitoring instrument health and status, support for mission operations, pre- and post-launch support, including end-to-end testing and initial 30-day on-orbit checkout. The operations and science analysis support shall continue for five years after launch upon successful completion of the spacecraft on-orbit checkout.

The effort includes meeting all programmatic requirements, such as managing the entire effort, supporting and attending reviews, reporting, deliverables, and cost and schedule management, control and reporting.

The contractor is responsible for ensuring that all the requirements in this contract are met. It is noted that other partnering organizations will perform some of the work in this instrument development (as delineated in the contractor's proposal to AO 99-OSS-03), however, the contractor has the responsibility under this contract to ensure that the work is accomplished within the cost and schedule requirements, and that all deliverables are met. This includes re-assigning work if a partner organization fails to fulfill it's agreed upon tasks. The remainder of this SOW describes the specific work to be performed only at the contractor's facilities,

including exercising oversight on the partner organizations to ensure adherence to specific requirements mentioned herein.

3.0 Applicable Documents

(1) GLAST Science Requirements Document - Attachment B to the contract.
(2) LAT Instrument – Spacecraft Interface Requirements Document - Revision A - Attachment G to the contract.

(3) Mission Assurance Requirements (MAR) for Large Area Telescope (LAT) - Attachment E to the contract.
(4) Announcement of Opportunity (AO) 99-OSS-03 "GLAST Flight Investigation."

4.0 Section is Reserved

5.0 Requirements

5.1 Formulation Phase

5.1.1 Formulation Phase Requirements

5.1.1.1 Management

The contractor shall provide oversight of the technical and resource management of the project. The contractor shall manage the project to assure that instrument, IOC and science investigation costs, schedule, performance, and all reporting requirements, are met. The instrument performance shall be managed to meet all requirements stated in the SRD and meet the interfaces in the IRD. The management shall oversee the administrative and technical direction, schedule control and reporting, financial control and reporting, subcontract management, configuration management and documentation, required reports, and implementation of a Performance Measurement System.

Ensure project control is provided to develop and maintain instrument project master schedule and budget. Include tracking actual costs and schedule performance of all subsystems and institution, and analyze performance compared to budget. Also includes developing plans with subsystem managers to resolve subsystem performance variances, and developing recovery plans.

5.1.1.2 System Engineering

Ensure that all system engineering activities are accomplished. These activities include analysis of all requirements, formulation of a system solution, and decomposition of requirements to subsystem elements. It also includes system-level trade studies, and establishment of budgets and reserves. Ensure development of specifications for the instrument and subsystems, and a requirements traceability capability to manage and trace requirements to the responsible subsystem or element.

Ensure development of interface requirements with the GSFC Project office for interfaces with the spacecraft and operations centers. Ensure participation in a GSFC led mission system engineering activity. Support development of ICDs between instrument subsystems.

Ensure that the following are provided:
-- A design integration function for the instrument, including integration of subsystem designs for mechanical, electrical, and software-related work.
-- A formal process for documenting and closing review action items.
-- Development of a system-wide test and verification plan. Review and approval of all subsystem procedures, drawings, analysis, and test data, to verify that design requirements are met.
-- System-level reliability and failure modes and effects (FMEA) analysis. Planning and implementation of a reliability program that interacts effectively with other project disciplines, including performance assurance, safety, and hardware design. Assure that adequate consideration is given to reliability during the design and development of hardware, including identifying redundant functions, single-point failures and their effects. Assure that the designed reliability is consistent among subsystems.
-- An Electrical, Electronic, and Electromechanical (EEE) Parts Control Program to assure that all parts selected for use in flight hardware meet mission objectives for quality and reliability. Establishment of a documented system to facilitate the management, selection, standardization, and control of parts and associated documentation. The system will ensure that all parts are reviewed and approved for conformance to established criteria and a Program Approved Parts List (PAPL) is developed and maintained.
-- Maintenance of updated error budgets as well as mass, power, and weight budgets and margins.
-- Evaluation of the impact on the instrument design of potential changes in the instrument requirements, external environment, or spacecraft design.

5.1.1.3 Science

Provide science support for the development of the flight instrument. Monitor and assess each element of the GLAST instrument design, to ensure compliance with science performance requirements. Perform overall science planning and coordination. This includes participating in and supporting the Science Working Group meetings and activities. Provide for analysis of science requirements. Conduct science workshops as appropriate. Support preparations for

coordinated data analysis efforts with other space-based detectors, ground based detectors, and detectors in other wavelengths.

Establish requirements for the data management plan. Support development of requirements for the event database. Support specification of science data analysis software. Support Specification of the algorithms using ground-based data and models.

Ensure development of a LAT calibration plan. Support the planning of the activities required to calibrate the instrument, including beam test requirements and plans.

Support the development of an instrument simulation model, for use in verifying flight software algorithms, ground software algorithms, and environment assumptions (e.g., cosmic ray background, albedo gamma-rays, and trapped radiation). Support the development and simulation of instrument performance metrics.

5.1.1.4 Instrument Design and Development

Manage and monitor the design and development of all subsystems of the LAT instrument, including the tracker, calorimeter, anticoincidence detector (ACD), data acquisition system (DAQ), and grid structure. Ensure that all subsystems are designed and developed within schedule and performance constraints. Ensure that all interfaces with the spacecraft meet the requirements specified in the IRD, and performance meets the requirements specified in the SRD.

Manage the DAQ development effort: personnel and facilities management, planning, budgeting, and reporting. Develop plans and schedules to meet operational and scientific DAQ requirements. Negotiate subcontracts as required with Co-Investigators and third parties for services and materials. Monitor task performance and review work breakdown structure and schedules. Prepare and submit regular status and progress reports to project management. Perform simulations and analyses to support development of data acquisition system requirements and specifications. Assess instrument trigger rates and their impact on data buffering, data flow, power consumption, and CPU performance. Participate in internal status reviews to assess each element of the DAQ design. Support quarterly progress reviews, external design and interface reviews, and mission design and readiness reviews. Derive and document DAQ specifications from the GLAST system specifications. Support the development of ICDs with other subsystems. Develop the DAQ verification plan. Assist in the development of the system verification program. Support travel to meetings, reviews, vendors, and development sites. Maintain a library of non-configuration controlled paperwork.

Contribute to the reliability analyses of the DAQ and power subsystems. Develop strategy to maximize DAQ MTBF based on selection of screening levels for EEE parts and implementation of fault tolerant design. Provide all resources associated with the overview and approval of EEE parts for the DAQ. Identify critical elements of the DAQ software and EGSE

software, for which special quality assurance procedures are to be implemented, followed and monitored. Develop the DAQ Quality Assurance plan.

DAQ Suborbital Flight Support
Modify and retrofit the prototype beam test DAQ for the instrument suborbital flight campaign. Support the integration and testing of the DAQ to the instrument engineering model and to the balloon gondola, and support the balloon flight. Provide TEMs for the balloon flight. Design, develop, and fabricate interface electronics between the TEMs and the balloon gondola electronics. Develop and fabricate a DAQ electronics enclosure, cable harness, and power supplies for the balloon unit. Support the payload integration and test. Support the balloon flight and perform data analysis on DAQ performance and background rejection.

Instrument Integration and Test
Ensure the development of integration and test plans for the instrument. Ensure that these plans conform to the overall cost and schedule constraints. Support the integration and test activities of each subsystem and ensure that they adhere to the same test standards and requirements. Ensure development of written procedures and specifications for the procurement, fabrication, and assembly of all ground support equipment needed for integration and functional and environmental testing, and calibration. Ensure that all required facilities will be available. Ensure that development of plans for instrument integration onto the spacecraft are supported.

Suborbital Flight
Ensure the necessary personnel, procedures, facilities, hardware and processes will be in place for all subsystems, to perform the necessary activities to fly, test and analyze the results of the beam test engineering model on a suborbital balloon flight. This test flight should be conducted as a means of demonstrating the ability of the instrument to handle the multi-component background encountered in a space flight environment.

5.1.1.5 Instrument Operations Center

The contractor shall manage the instrument operations effort and provide personnel and facilities management, planning, budgeting, and reporting. Develop plans and schedules for meeting the operational and scientific requirements of the instrument operations and data processing efforts.

Mission Operations Planning
Document the requirements on the various components of the IOC as derived from the science requirements, instrument functional requirements, mission requirements, Science Support Center requirements, mission operations center requirements, and developments in theory and technique. Develop specifications for the IOC and DPF that include support for both ground and space-based commanding and data acquisition. Support the development of ICDs with the SSC, MOC, NASCOM, and the flight instrument. Develop plans to support instrument and

mission systems integration and test. Include support for instrument commanding and verification of commands and procedures. Develop plans to acquire and archive engineering and calibration measurements. Develop plans to deliver I&T data to the science team and support development of a calibration parameter table for the whole instrument as a function of instrument settings, temperature, spacecraft parameters and other variables.

5.1.1.6 Performance Assurance

The contractor shall ensure the use of an acceptable performance assurance program for all flight hardware and software development efforts related to GLAST. It shall also apply to GSE that interfaces directly with flight hardware. The predominant assurance objective is that GLAST will operate in a safe and environmentally sound manner, and will meet the science objectives and corresponding measurement requirements specified in the GLAST Science Requirements Document. The performance assurance program shall meet the intent of the Mission Assurance Requirements for GLAST LAT document. This shall include a quality assurance program that is consistent with the ISO 9000 series, American National Standard, Quality Systems – Model for Quality Assurance in Design, Development, Production, Installation, and Servicing, ANSI/ASQC Q9001-1994. The use of contractor established procedures is encouraged.

This function shall have sufficient staff and facilities to provide the required reliability engineering, parts engineering, quality assurance engineering, system safety and hazard analysis, development of workmanship standards, problem/failure resolution reporting, and materials control for the fabrication, integration, acceptance testing, and calibration of the engineering and flight units. The program shall be implemented by conducting analyses, reviews, tests and inspections, and by appropriate management of the associated records, reports, and other performance assurance-related documentation.

The contractor shall ensure that a Performance Assurance Plan is developed and submitted for review and approval by the Contracting Officer's Technical Representative for this contract.

5.1.1.7 Reviews, Meetings and Reports

The contractor shall support the following reviews. Locations will vary from the contractor's facility to partner organization facilities to GSFC.

a. System Requirements Review;
b. Preliminary Design Review;
c. In addition to the above instrument reviews, support the mission SRR, PDR;
d. Non-advocate Review; and
e. Quarterly Reviews. Information shall be provided, but not limited to: current design status for each subsystem; progress since last quarterly review; activities planned for the next quarter; any proposed changes to design; identified risks and plans for mitigation; issues

and concerns; business management issues, i.e., short and long term schedules (actual vs. planned), staffing, budget and costing (actual vs. planned); planned vs. current estimate of technical resources (e.g., mass, power, volume, and data rate). Alternating quarterly reviews may be combined with, or replaced by, reviews chaired by the Department of Energy, a partner organization, with NASA participation.

Additional meetings:

a. Regularly scheduled technical interface /accommodation meetings (these may be part of the quarterly reviews).

Reports:

a. Weekly formal technical reports providing work accomplished, work planned for the next quarter, and technical and programmatic issues.
b. Informal weekly reports of work accomplished during that week.
c. Monthly and Quarterly 533s or equivalent.

5.1.1.8 Education and Public Outreach

Ensure that a comprehensive education and public outreach program is implemented, which is consistent with the NASA Headquarters Office of Space Science education and public outreach strategy.

5.1.2 Work Schedule

The work shall be performed consistent with meeting the following major milestone schedule: PDR – January 2002; End of formulation phase – May 31, 2002.

5.2 Implementation Phase

5.2.1 Implementation Phase Requirements

5.2.1.1 Management

The contractor shall provide oversight of the technical and resource management of the project. The contractor shall manage the project to assure that instrument, IOC and science investigation costs, schedule, performance, and all reporting requirements, are met. The instrument performance shall be managed to meet all requirements stated in the SRD and meet the interfaces in the IRD. The management shall oversee the administrative and technical direction, schedule control and reporting, financial control and reporting, subcontract management, configuration management and documentation, required reports, and implementation of a modified Performance Measurement System. .

Ensure project control is provided to develop and maintain instrument project master schedule and budget. Include tracking actual costs and schedule performance of all subsystems and institution, and analyze performance compared to budget. Also includes developing plans with subsystem managers to resolve subsystem performance variances and developing recovery plans.

The contractor shall manage all partner organizations, both domestic and foreign, such that the schedules, performance and reporting requirements are met for all subsystems. This includes managing the required Memoranda of Agreement between team member institutions.

5.2.1.2 System Engineering

Ensure that all system engineering activities are accomplished. These activities include maintenance of requirements traceability, and assurance that all requirements are accounted for. It also includes system-level trade studies, and maintenance of budgets and reserves.

Ensure participation in a GSFC-led mission system engineering activity. Ensure support for development of ICDs between instrument and spacecraft, and maintenance and update of ICDs between instrument and MOC, and between instrument subsystems.

Ensure that the following activities are provided:
-- A design integration function for the instrument, including integration of subsystem activities for mechanical, electrical, and software-related work.
-- A formal process for documenting and closing review action items.
-- Implementation of the system-wide test and verification plan. Review and approval of all subsystem procedures, drawings, analysis, and test data, to verify that design requirements are met. Expand plan to cover requirements for instrument delivery, spacecraft integration, and launch and mission operations test support.
-- Refine system-level reliability and failure modes and effects (FMEA) analysis. Implement a reliability program that interacts effectively with other project disciplines, including performance assurance, safety, and hardware design. Assure that adequate consideration is given to reliability during the design and development of hardware, including identifying redundant functions, single-point failures and their effects. Assure that the designed reliability is consistent among subsystems.
-- Maintain an Electrical, Electronic, and Electromechanical (EEE) Parts Control Program to assure that all parts selected for use in flight hardware meet mission objectives for quality and reliability. Execute the documented system to facilitate the management, selection, standardization, and control of parts and associated documentation.
-- Maintenance of updated error budgets as well as mass, power, and weight budgets and margins.
-- Evaluation of the impact on the instrument design of potential changes in the instrument requirements, external environment, or spacecraft design.

5.2.1.3 Science Preparation

Provide science support for the development of the flight instrument. Monitor and assess each element of the GLAST instrument design, to ensure compliance with science performance requirements. Perform overall science planning and coordination. This includes participating in and supporting the Science Working Group meetings and activities. Provide scientific advice to the GSFC GLAST Project. Conduct science workshops as appropriate and coordinate joint observing campaigns. Coordinate data analysis efforts with other space-based detectors, ground based detectors, and detectors in other wavelengths.

Assure that the data management plan is properly implemented. Support the implementation of the event databaseSupport specification and documentation of science data analysis software. Specify and prototype the algorithms using ground-based data and models.

Finalize and implement the LAT calibration plan. Plan, coordinate and perform the activities required to calibrate the instrument. Include measurements made with both external reference systems and on-board instrument calibration systems. Evaluate the effectiveness of the calibration techniques. Review and refine beam test requirements and plan.

Support development of the required software, algorithms, code and tools, and perform science investigations using simulated data sets and GLAST instrument data. Publish results of scientific analysis in refereed scientific journals.

5.2.1.4 Instrument Design and Development

Manage and monitor the design and development of all subsystems of the LAT instrument, including the tracker, calorimeter, anticoincidence detector (ACD), data acquisition system (DAQ), and grid structure. Ensure that all subsystems are designed and developed within schedule and performance constraints. Ensure that all interfaces with the spacecraft meet the requirements specified in the IRD, and performance meets the requirements specified in the SRD. Ensure the necessary activities for instrument integration and test, and support for integration and test with the spacecraft and launch and early orbit support. Prepare and submit regular status and progress reports to project management. Participate in internal status reviews to assess each element of the design. Support quarterly progress reviews, external design and interface reviews, and mission design and readiness reviews. Support travel to meetings, reviews, vendors, and development sites. Maintain a library of non-configuration controlled paperwork.

Electronics, Data Acquisition and Flight Software (DAQ)
Manage the DAQ development effortand provide personnel and facilities management, planning, budgeting, and reporting. Develop plans and schedules to meet operational and scientific DAQ requirements. Negotiate subcontracts as required with Co-Investigators and third parties for services and materials. Monitor task performance and review work breakdown

structure and schedules. Perform simulations and analyses to support development of data acquisition system requirements and specifications. Assess instrument trigger rates and their impact on data buffering, data flow, power consumption, and CPU performance. Implement DAQ specifications and requirements into the design of each element. Support the development and updates of ICDs with other subsystems, the GSFC GLAST Project office, the spacecraft, and operations segments. Implement the DAQ verification plan. Assist in the development of the system verification program. Participate in the verification efforts and evaluate the results of various tests.

In conjunction with partner organizations, perform reliability analyses of the DAQ and power subsystems. Develop strategy to maximize DAQ MTBF based on selection of screening levels for EEE parts and implementation of fault tolerant design. Provide all resources associated with the overview and approval of EEE parts for the DAQ. Identify critical elements of the DAQ flight software and EGSE software, for which special quality assurance procedures are to be implemented, followed and monitored. Review and approve all flight materials needed for the DAQ. Validate all parts lists and determine amount of testing/screening is needed for each flight part. Update the DAQ Quality Assurance plan, and monitor its implementation. Perform flight quality inspections of all DAQ flight hardware. Validate and verify DAQ procedures, drawings, inspections and tests.

In conjunction with partner organizations, fabricate, assemble and test all components of the DAQ, including engineering models, qualification units, flight units and spares. Activities include simulations and testbed activities, establishing technical performance measures, integration and functional and environmental testing.

Ground Support Equipment

Along with other partner organizations, design, fabricate and test all electrical and mechanical ground support equipment (GSE) needed to support the DAQ development, integration and test activities. Develop or procure software for the EGSE. Develop a low fidelity spacecraft interface simulator for use with the engineering models and the DAQ testbed. Deliver the EGSE for use during instrument integration.

Instrument Integration and Test

Ensure the development of integration and test plans and procedures for the flight instrument and calibration unit. Ensure that these plans conform to the overall cost and schedule constraints and adhere to the GSFC GLAST Project overall integration and test plan, including verification requirements. Support the integration and test activities of each subsystem and of the flight instrument and calibration unit, and ensure that they adhere to the same test standards and requirements. Ensure development of written procedures and specifications for the procurement, fabrication, and assembly of all ground support equipment needed for integration and functional and environmental testing, and calibration. Ensure that all required facilities will be available. Ensure the development and execution of plans and procedures for instrument integration and test onto the spacecraft. Ensure this support carries through launch operations,

and supports a 30-day initial on-orbit checkout period. This includes end-to-end tests before launch. Provide engineering support for continuous environmental testing of the integrated spacecraft, at the spacecraft contractor's facility. Provide continuous support of functional testing and data analysis/evaluation of the instrument prior to launch, and during subsequent on-orbit checkout.

Including the use of the IOC, provide end-to-end testing support for the instrument testing and observatory level testing. This includes verification of commands and procedures, and verifying instrument science data and housekeeping telemetry acquisition and data processing. Support instrument commanding as required for instrument test. Track and verify red and yellow telemetry limits and provide operator warnings for threat conditions. Collect and organize all calibration data made with both external reference systems and on-board instrument calibration systems. Evaluate the effectiveness of the calibration software and approach. Support ground systems compatibility test definition and performance. Support the integrated operations training and simulations as required. Verify the entire telemetry acquisition, monitoring, command processing, and data processing system during on-orbit checkout.

5.2.1.5 Instrument Operations Center

The contractor shall manage the instrument operations effort and provide personnel and facilities management, planning, budgeting, and reporting. Develop plans and schedules for meeting the operational and scientific requirements of the instrument operations and data processing efforts. Establish special site requirements of major hardware components (computers and data storage system) including floor space and access space, electrical and cabling requirements, operations environmental conditions, environmental conditions for media storage, security, storage space, and work space. Prepare appropriate site facilities for hardware and for off-line media storage. Arrange connectivity and sufficient bandwidth and reliability for data transfer to/from the IOC and DPF, and through NISN to the Science Support Center (SSC), Mission Operations Center (MOC), and other NASA centers and team members as required. Provide materials and services that support the IOC development effort including computer systems and software. Provide computer hardware maintenance and software licenses.

Mission Operations Planning
Continue to support the development of ICDs with the SSC, MOC, and the flight instrument. Coordinate plans to acquire and archive engineering and calibration measurements taken with the prototype and flight instruments. Plan initial operations to provide instrument verification and calibration after launch. Develop procedures and contingency plans to identify and resolve in-flight anomalies. Develop plans to monitor instrument status and health, and generate command loads to initiate specific functions and modify on-board programming. Create contingency plans and emergency preparedness procedures with instrument team. Create procedures for alerting the instrument team of anomalies or potential targets of opportunity (TOOs).

LAT Operations Facility (LOF)
Provide an LOF for monitoring the status and health of the instrument and instrument performance for the duration of the mission. This includes real-time and playback data acquisition, health and status telemetry processing, data display and analysis (including trend analysis), and quicklook instrument science data processing and analysis. Develop database of red and yellow limits for instrument health and safety monitoring. Develop planning and analysis tools to perform the functions described above. Develop and maintain a command and telemetry database. Develop command procedures and command verification procedures. Specify, acquire, and install the workstation configuration to support data access, data analysis, data storage, and communication at the LOF. Provide the interface to the MOC, SSC and remote sites through a network interface to NISN. Ensure that the LOF is operated, maintained, and all above functions are implemented, for the duration of the mission.

5.1.2.6 Science Analysis Software

The contractor shall manage the LAT science data processing effort and provide personnel and facilities management, planning, budgeting, and reporting. Develop plans and schedules for meeting the operational and scientific requirements of LAT data processing efforts. Establish special site requirements of major hardware components (computers and data storage system) including floor space and access space, electrical and cabling requirements, operations environmental conditions, environmental conditions for media storage, security, storage space, and work space. Prepare appropriate site facilities for hardware and for off-line media storage. Arrange connectivity and sufficient bandwidth and reliability for data transfer to/from the DPF through NISN to the Science Support Center (SSC) and other NASA centers and team members as required. Provide materials and services that support the SAS development effort including computer systems and software. Provide computer hardware maintenance and software licenses. Develop and implement a data management plan for the LAT science data analysis. Design, develop, and maintain the LAT Data Processing Facility. Develop and implement the event database. Support specification, development, maintenance, testing and documentation of science data analysis software. Prepare code for converting raw data to inferred physical quantity measurements including photon energy and source location. Specify and prototype the algorithms using ground-based data and models.

Implement the LAT calibration plan. Plan, coordinate and perform the activities required to analyze data to calibrate the instrument. Include measurements made with both external reference systems and on-board instrument calibration systems. Evaluate the effectiveness of the calibration techniques. Refine beam test data analysis requirements and plan. Finalize the calibration database to be used by the Level 1 data reduction software.

Validate and improve the instrument simulation model, for use in verifying flight software algorithms, ground software algorithms, and environment assumptions (e.g., cosmic ray

background, albedo gamma-rays, and trapped radiation). Develop and refine instrument performance metrics and validate using the instrument simulation.

Develop the required software, algorithms, code and tools to support LAT science investigations using simulated data sets and GLAST instrument data.

5.2.1.7 Performance Assurance

The contractor shall ensure the use of an acceptable performance assurance program for all flight hardware and software development efforts related to GLAST. It shall also apply to GSE that interfaces directly with flight hardware. The predominant assurance objective is that GLAST will operate in a safe and environmentally sound manner, and will meet the science objectives and corresponding measurement requirements specified in the GLAST Science Requirements Document. The performance assurance program shall meet the intent of the Mission Assurance Requirements for GLAST LAT document. This shall include a quality assurance program that is consistent with the ISO 9000 series, American National Standard, Quality Systems – Model for Quality Assurance in Design, Development, Production, Installation, and Servicing, ANSI/ASQC Q9001-1994.
This function shall have sufficient staff and facilities to provide the required reliability engineering, parts engineering, quality assurance engineering, system safety and hazard analysis, development of workmanship standards, problem/failure resolution reporting, and materials control for the fabrication, integration, acceptance testing, and calibration of the engineering and flight units. The program shall be implemented by conducting analyses, reviews, tests and inspections, and by appropriate management of the associated records, reports, and other performance assurance-related documentation.

The contractor shall ensure that a Performance Assurance Plan is developed and submitted for review and approval by the Contracting Officer's Technical Representative for this contract.

5.2.1.8 Reviews, Meetings and Reports

The contractor shall support the following reviews. Locations will vary from the contractor's facility to partner organization facilities to GSFC.

a. Critical Design Review;
b. Pre-environmental Review;
c. Pre-ship Review;
d. In addition to the above instrument reviews, support the mission SRR, PDR, CDR, PER, and PSR;
e. Mission Operations Review;
f. Flight Readiness Review;
g. Software Critical Design Review (may be part of the CDR);
h. Calibration Review; and

i. Quarterly Reviews. Information shall be provided, but not limited to: current design status for each subsystem; progress since last quarterly review; activities planned for the next quarter; any proposed changes to design; identified risks and plans for mitigation; issues and concerns; business management issues, i.e., short and long term schedules (actual vs. planned), staffing, budget and costing (actual vs. planned); planned vs. current estimate of technical resources (e.g., mass, power, volume, and data rate).

Additional meetings:

a. Regularly scheduled technical interface /accommodation meetings (these may be part of the quarterly reviews).

Reports:

a. Weekly formal technical reports providing work accomplished, work planned for the next quarter, and technical and programmatic issues.
b. Informal weekly reports of work accomplished during that week.
a. Monthly and Quarterly 533s or equivalent.

5.2.1.8 Education and Public Outreach

Ensure that a comprehensive education and public outreach program is implemented, which is consistent with the NASA Headquarters Office of Space Science education and public outreach strategy.

5.2.2 Work Schedule

The period of performance for the implementation phase of this effort is from June 1, 2002, through April 14, 2006.

5.2.3 Deliverables

The contractor shall ensure delivery of all items in the deliverables list of the contract.

5.3 Mission Operations and Data Analysis (MO&DA) Phase

5.3.1 LAT Operations

The contractor shall manage LAT operations and data processing including personnel and facilities management, planning, budgeting, and reporting. The contractor shall develop plans and schedules to meet operational and scientific requirements of the LAT operations and data processing efforts. The contractor shall provide and maintain facilities for LAT operations and data processing including computers, displays, data storage systems, electrical and cabling infrastructure, environmental control, media storage, network security, and access controlled

workspace. The contractor shall arrange network connectivity with sufficient bandwidth and reliability for data transfer within the operations and data processing facilities, and through NISN to the GLAST Science Support Center (SSC), GLAST Mission Operations Center (MOC), and other NASA centers and LAT team members. The contractor shall provide materials and services to support the operations and data processing efforts including computer systems, software, and maintenance. The contractor shall support crew resource management, process improvement, and performance assurance including configuration management for the operations and data processing efforts.

The contractor shall provide the operations facility for monitoring the health, status, and performance of the LAT for the duration of the mission. The contractor shall acquire and verify real-time and playback level 0 data, perform health and status telemetry processing, display data, analyze trends, and generate quick look science data. The contractor shall maintain and update the operations database including command, telemetry, engineering calibration, and monitoring limits for instrument health and safety. The contractor shall verify and maintain command procedures, sequences, and upload verification procedures. The contractor shall perform science and operations planning and coordinate inputs to the observing program with the SWG, the SSC, and other LAT investigators. The contractor shall build the observing sequences and command loads required for implementing the observing plan. The contractor shall generate and verify instrument command loads to initiate specific functions and modify on-board programming. The contractor shall submit the command loads and configuration commands and procedures to the MOC and shall monitor and validate the command histories generated by the MOC. The contractor shall develop and implement procedures and contingency plans to identify and resolve in-flight anomalies. The contractor shall create contingency plans and emergency preparedness procedures in conjunction with experiment team. The contractor shall implement and exercise procedures for alerting instrument team members in the event of instrument or spacecraft anomalies or the existence of potential targets of opportunity. The contractor shall update, verify, and support planning and analysis tools to perform the functions described above. The contractor shall maintain and upgrade as required the hardware and software configuration to support data access, data analysis, data storage, and communication at the operations facility. The contractor shall maintain the interface to the MOC, SSC, and remote sites through the network interface and ensure that the operations facility is operated, maintained, and all above functions supported, for the duration of the mission.

The contractor shall perform science data processing and analysis to support instrument calibration, science data quality assessment, and transient alert notification and verification. The contractor shall acquire and verify level 0 data, perform data reduction procedures, catalog raw data and reduced data sets, distribute and archive data. The contractor shall specify, develop, upgrade, maintain, test and document LAT data processing and science data analysis software.

The contractor shall develop and implement data processing software to calibrate and verify the science performance of the LAT. The contractor shall update and maintain the calibration

database used by the Level 1 data reduction software. The contractor shall maintain and improve the instrument simulation model, for use in verifying flight software algorithms, ground software algorithms, and environment assumptions, and for deriving instrument performance metrics. The contractor shall develop the required software, algorithms, code and tools to distribute LAT data and perform LAT science investigations.

The contractor shall perform incremental and permanent archival backups of software and selected on-line data on external media and systems on a regular schedule. The contractor shall maintain operations and data processing facility systems through combinations of warranty agreements, service contracts, and self-maintenance. The contractor shall support and maintain the LAT flight software testbed for use in validating the observing programs, flight software updates, and instrument command sequences prior to delivery to the MOC. The contractor shall provide thermal, electronics, and flight software engineering support as required.

5.3.2 LAT Science Analysis

The contractor shall provide overall science planning and coordination for the LAT team. The contractor shall participate in and support the Science Working Group and provide advice to the GLAST Project Scientist. The contractor shall provide science planning oversight, conduct science workshops, coordinate joint observing campaigns, and coordinate data analysis efforts with other space-based detectors, ground based detectors, and detectors in other wavelengths as appropriate to meet LAT science objectives.

The contractor shall assure that the data management plan is properly implemented including the implementation of the LAT science database. The contractor shall support specification, development, upgrade, maintenance, test and documentation of science data analysis software.

The contractor shall plan, coordinate and perform the activities required to calibrate and verify the science performance of the LAT. The contractor shall update and maintain the calibration database used by the Level 1 data reduction software. The contractor shall verify and improve the instrument simulation model, for use in verifying flight software algorithms, ground software algorithms, and environment assumptions and for deriving instrument performance metrics. The contractor shall develop the required software, algorithms, code and tools, perform science investigations using GLAST instrument data, and publish results of scientific analysis in refereed scientific journals.

5.3.3 MO&DA Period of Performance

The period of performance for the MO&DA phase of the effort will begin April 15, 2006, last for a period of five years and end on April 14, 2011.

End of GLAST SOW